2013 Initial Project Quad Charts

NASA ENERGY AND WATER CYCLE STUDY

NEWS

NEWS Challenge:

Document and enable improved, observationally-based, predictions of water and energy cycle consequences of Earth system variability and change.

Program Manager: J. Entin (NASA-HQ)
Project Scientist: P. Houser (GMU)
Sr. Project Scientist: R. Schiffer (USRA)
Focus Area Liaison: D. Belvedere (MSU)

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The role of boundary layer clouds in the global energy and water cycle: An integrated assessment using satellite observations

NASA ENERGY AND WATER CYCLE STUDY NEWS

PI: Ralf Bennartz   Team: R.E. Holz

Objective:

•Study quantify the variability of cloud droplet number concentration, cloud geometrical thickness, cloud liquid water, and rain water path, as well as their impact on shortwave albedo and precipitation generation.

Approach:

•Regional and global studies of the variability of the aforementioned parameters will be performed. These studies will allow estimating the impact of e.g. biomass burning events on cloud albedo and precipitation generation. Each step will be accompanied by an extensive error analysis of all components within the process leading to uncertainty estimates for all derived parameters.

Data/Models:

•Aqua-MODIS and AMSR-E dataset starting at level 2. To achieve this, the study will make use of the Atmosphere Product and Evaluation Test Element (PEATE) located at the University of Wisconsin's Space Science and Engineering Center (SSEC).

Value Added Integration (planned):

•Integrated assessment of microphysical and radiative effects of marine boundary layer clouds.

•Dataset available to science community

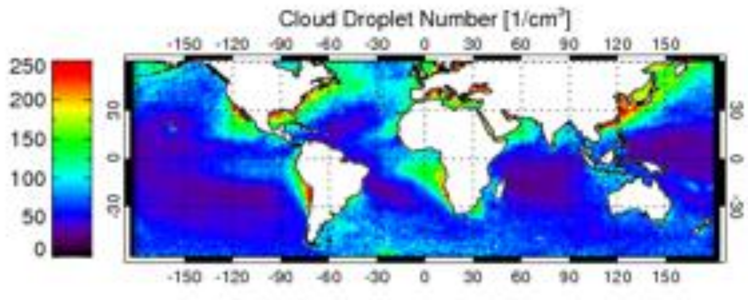


Figure 1. Global cloud droplet number concentration of warm clouds (cloud top temperature larger 273 K) for one year (2003) of combined AMSR-E and MODIS observations.

Initial task timeframe (in bullet form):

- 04/13: Case study selection; acquire datasets
- 10/13Reevaluate based on MODIS Collection 6
- 04/14: Statistical analysis; case studies
- 10/14: Peer reviewed publication. Make dataset available to community.

Needs/requests (in bullet form):

- Connection w/Rapp and other projects.
- Summary/status of prior working group and integration activities to inform both new and continuing NEWS PIs and aid future integration.

Date submitted: FEbrurary2012

Initial Entry Slide

Observed Tropical Expansion: Impact on the Hydrological and Energy Cycles

Robert Allen (UCR), Joel Norris (UCSD/SIO), Dargan Frierson (UW) and Mahesh Kovilakam (UCR)

Objectives:

1. Quantify the hydrological consequences of recent tropical expansion, as well as meridional shifts in the ITCZ.
2. Investigate possible mechanisms, and reasons why models underestimate recent observational estimates.
3. Extend analysis back ~100 years using the 20th Century Reanalysis.

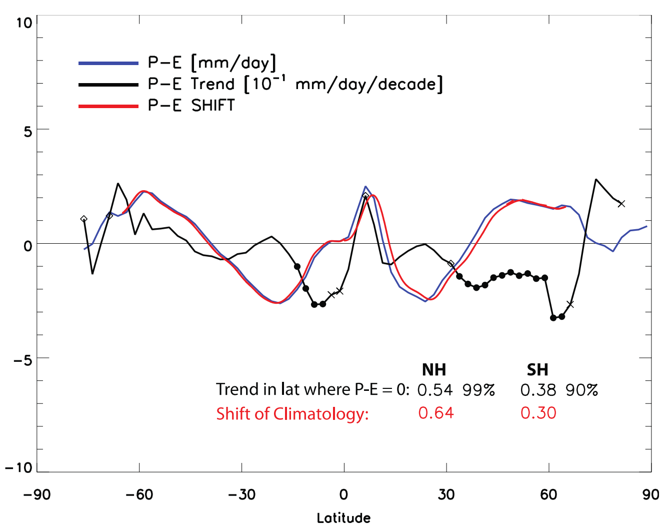
Approach:

1. Focus on zonal displacements of the subtropical dry zones and mid-latitude storm tracks, and possible associated changes in hydrological extremes.
2. Evaluate the role of natural variability (ENSO), anthropogenic forcings (GHGs, ozone, aerosols) and SSTs.
3. Relate hydrological changes to dynamics using MERRA.

Data/Models:

GPCP precipitation, WHOI OAFlux evaporation, ISCCP & PATMOS-x cloud cover, MERRA and 20th Century Reanalyses, CMIP5 simulations, GLDAS models, and CAM5.

Value Added Integration (planned):



1983-2008 poleward displacement of the subtropical dry zones based on GPCP precipitation minus WHOI OAFlux evaporation.

Initial task timeframe (in bullet form):

- 01/2013 Quantification of tropical expansion in CMIP5 models, including the various miscellaneous forcing (e.g., GHG-only, aerosol-only, AMIP) experiments. Initial findings show an interesting result: AMIP simulations feature much larger expansion than atmosphere-ocean coupled simulations, and much larger than any previously reported model estimates.
- 01/2013 Quantify tropical expansion and investigate mechanisms using MERRA and 20th Century Reanalyses.
- 03/2013 Run idealized CAM5 simulations to evaluate the role of SSTs (e.g., PDO).

Needs/requests (in bullet form):

Date submitted: Feb 2013

Initial Entry Slide

Quantifying observation influence on regional water budgets in reanalyses

PI: **Michael G. Bosilovich** Team: Franklin R. Robertson, J. Brent Roberts, Arlindo M. da Silva and David Mocko

Objective:

•*Explain variations in regional water and energy budgets of reanalyses using assimilated observations and forecast error*

•*Identify the observations that control regional weather and climate features in the reanalysis, beginning with the U.S dominated by conventional observations and extending to the tropics and Africa*

Approach:

•Refine update and maintain a new data set of gridded reanalysis observations, develop statistical metrics based on

•Evaluate regional budget imbalances in terms of assimilated observations and forecast errors.

• Evaluate model biases in tropical teleconnections vis-a-vis observational radiances influence in understanding statistics generated in US and other regional water / energy budgets.

Data/Models:

•NASA's Modern Era Retrospective analysis for Research and Applications (MERRA)

•A new ancillary MERRA data set called Gridded Innovations and Observations (GIO)

•National Multi-Model Ensemble, NMME, (esp GMAO component)

Potential Value Added Integration:

•Coupling analysis for MERRA, MERRA-Land, and MERRA-GIO (Santanello)

•Quantifying systematic forecast error during drought (Oglesby, Schubert)

•Sensitivity of extreme precipitation to observations in MERRA (Wang)

•Relationship of the diurnal cycle to increments and forecast error in the energy and water cycle (Taylor)

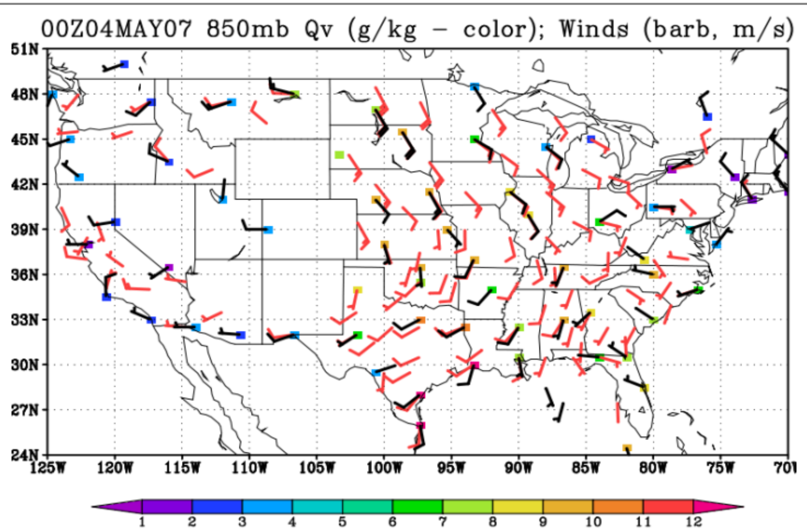


Figure 1. *GIO derived 850 mb radiosonde specific humidity (colored boxes) and winds (black barbs) and the LIDAR Profiler network winds (red barbs).*

Initial task timeframe:

- 06/13: Analyze MERRA water vapor divergence in the US using GIO observations and MERRA background forecast errors
- 12/13: Analysis of GMAO NMME seasonal skill in regional precipitation experimental forecasts
- 06/14: Analyze the radiance data assimilation influence on MERRA regional water and energy budgets
- 12/14: Extend analysis to other NMME members. Interpret observations and model diagnostics in terms of NAWP initiative

Needs/requests:

- Request to NMME to produce more model diagnostics
- Quantitative estimates of water used for irrigation in the US, and the impact on evapotranspiration

Investigation of Earth radiation budget variability by cloud object

Seiji Kato[1] (PI), Kuan-Man Xu[1], Takmeng Wong[1], Patrick C. Taylor[1], Tristan S. L'Ecuyer[2]

[1]NASA Langley Research Center, [2] University of Wisconsin

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Objective:

- Understand top-of-atmosphere (TOA) and surface radiation budget variability
- Understand the relationship between TOA radiation budget variability and cloud object variability
- Understand cloud object change by dynamical state or sea surface temperature

Approach:

- Radiation budget variability is investigated using CERES EBAF data set.
- Cloud objects are determined using a 20 km resolution (CERES footprint) following an approach taken by Xu et al. (2005).
- Cloud properties of 10 types of cloud object are investigated using CALIPSO, CloudSat, and MODIS derived cloud properties
- TOA and surface radiative fluxes variability and relationship with cloud object PDF and their properties are investigated.

Cloud objects to be considered in this study

Cloud system type	Cloud top height	Cloud optical depth	Cloud fraction	Latitude band
Tropical deep convection	> 440 (hPa)	> 10	1.0	25°S-25°N
Trade/shallow cumulus	< 680 hPa	—	0.1 – 0.4	40°S-40°N
Transition stratocumulus	< 680 hPa	—	0.4 – 0.99	40°S-40°N
Solid stratus	< 680 hPa	—	0.99 – 1.0	40°S-40°N
Altocumulus	440 hPa < h < 680 hPa	—	0.1 – 0.4	40°S-40°N
Transition altocumulus	440 hPa < h < 680 hPa	—	0.4 – 0.99	40°S-40°N
Solid altocumulus	440 hPa < h < 680 hPa	—	0.99 - 1.0	40°S-40°N
Cirrus	> 440hPa	< 10	0.1 – 0.4	40°S-40°N
Cirrocumulus	> 440 hPa	< 10	0.4 – 0.99	40°S-40°N
Cirrostratus	> 440 hPa	< 10	0.99 – 1.0	40°S-40°N

Data/Models:

- NEWS CCCM and CERES SSF data products.
- Cloud object data (derived using MODIS only)
- CERES EBAF (Radiation budget data product)

•CCCM contains observations from CERES, MODIS, CALIPSO, and CloudSat (http://eosweb.larc.nasa.gov/project/ceres/level2_cccm_table.html)

•SSF contains observations from CERES and MODIS. (http://eosweb.larc.nasa.gov/PRODOCS/ceres/level2_ssf_table.html)

•Cloud object data (http://cloud-object.larc.nasa.gov/)

•EBAF (http://ceres.larc.nasa.gov/order_data.php)

Value Added Integration (planned):

Initial task timeframe (tentative)::

•January-March 2013: Cloud object subletting from SSF and CCCM

•April-July/2013: Initial analysis of cloud objects, comparison with previous results (Xu et al. 2007, 2006, 2007, 2008)

•Aug. – Dec./2013: Initial analysis of active sensor derived cloud properties

•Jan-Sep/2014: Understanding relationship between cloud objects and radiation variability.

Needs/requests (in bullet form):

Date submitted:

Initial Entry Slide

Quantifying the water and energy budgets in marine subsidence regions

PI: Anita Rapp (Texas A&M University)

Objectives:

- Characterize the water and energy cycles in marine subsidence regions
- Develop a precipitation climatology from CloudSat to assess differences between existing P estimates
- Evaluate moisture and energy fluxes in MERRA

Approach:

•Use NEWS and NASA datasets to estimate the components of water and energy budgets in four boundary layer cloud regions
•Compare multiple estimates to establish the uncertainties
•Quantify potential rainfall biases in products that use conventional precipitation sensors
•Use observational estimates to evaluate regional water budget in MERRA

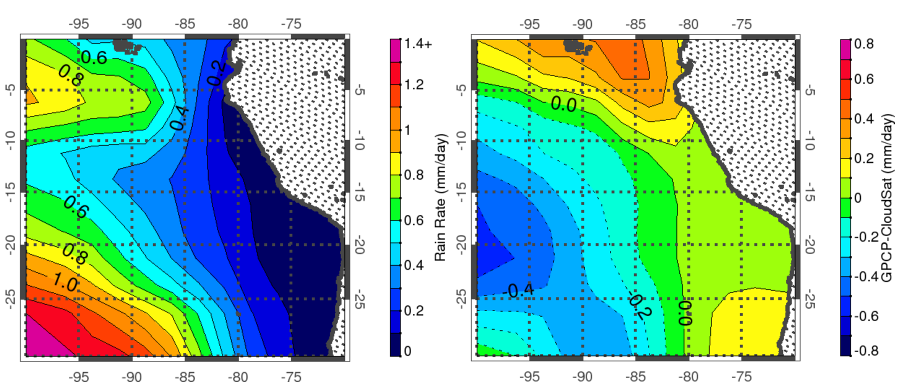

Figure 1. Regional precipitation climatology (mm day^{-1}) for the southeastern Pacific marine subsidence region from CloudSat (left) and the difference between GPCP and CloudSat (right) showing existing products underestimate in region of most frequent low cloud precipitation (not shown).

Data/Models:

•Surface evaporation and heat fluxes: GSSTF3, SeaFlux, OAFlux
•Surface/Atmo Radiation: CERES, GEWEX SRB, CloudSat Fluxes & Heating Rates (2B-FLXHR-LIDAR)
•Atmospheric moisture flux divergence: PMWC
•Precipitation: CloudSat 2C-RAIN-PROFILE, GPCP, CMAP, PMWC

Value Added Integration (planned):

•Assessment of cloud impacts in boundary layer cloud regions (Bennartz)
•Flux comparisons in boundary layer regions with conditional sampling methodology (Su)
•Variability in fluxes low cloud regions (Kato, Taylor)

Initial task timeframe (in bullet form):

- 03/13: Assemble all datasets for computing terms in water & energy budgets
- 05/13: Complete comparisons of regional surface precipitation climatologies
- 09/13: Compute regional evaporation and atmospheric moisture flux divergence terms
- 12/13: Determine uncertainties and evaluate regional water budget closure
- 05/14: Compute and intercompare regional radiation budgets
- 12/14: Compare observational regional water & energy budgets to MERRA

Needs/requests (in bullet form):

•SeaFlux data

Date submitted: January 2013

Initial Entry Slide

Global Precipitation Variations and Extremes

R. Adler (UMD), G. Gu (UMD), G. Huffman (GSFC), S. Curtis (ECU)

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Objective: Determine how the characteristics of global and regional precipitation are changing in terms of means, variations and extremes and integrate this information into global energy/water cycle studies.

Approach: Analyze the GPCP precipitation record along with other shorter, high quality precipitation data sets such as TRMM, other global data sets (e.g., surface temperature, water vapor), Also compare observational results with global re-analyses and climate models. Examine ENSO and volcano impacts on precipitation record and carefully diagnose trends, both regionally and globally. Relate changes over the last 30 years to these forcings and inter-decadal variations, including PDV. Estimate pattern of precipitation change due to global warming.

Data/Models: GPCP and TRMM precipitation data sets, other global data sets for surface temperature, water vapor and other variables. MERRA, 20CR and other re-analyses, and CMIP and AMIP climate model runs.

Value Added Integration (planned): 1) complete global and continental climatological mean water and energy balance study with Rodell et al. and 2) integrate our studies of variations and trends of precipitation with other NEWS studies for more complete study of aspects of climate change.

Global Changes (1988-2008)

Surface Temp. (Amplitude ~ .2C)

Water Vapor (~ 7%/C for ENSO, ~6%/C for volcano)

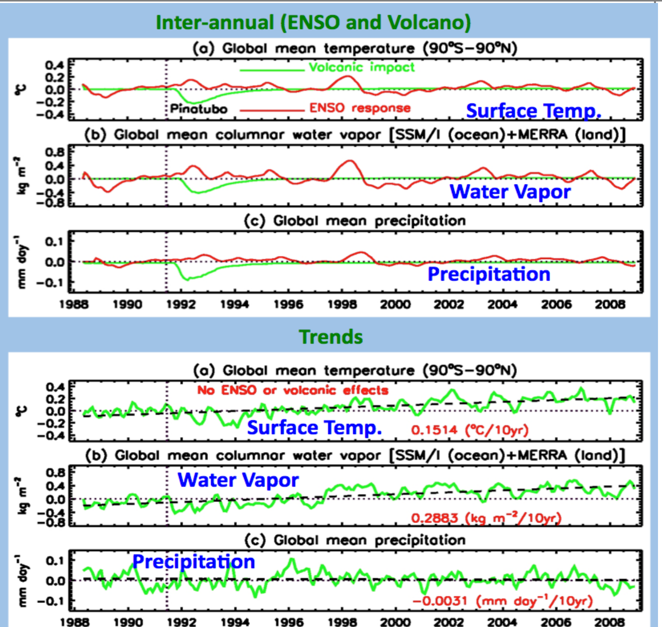
Precipitation (~ 2%/C for ENSO, ~4%/C for volcano)

Surface Temp. (.15 C/10yr)

Water Vapor (~ 7%/C, taking into account MERRA trend bias)

Precipitation (~ 0%/C)

Gu and Adler 2011 Int.J.Clim.



Global variations and trends in precipitation, temperature and water vapor

Expected Progress:

- Manuscript on climatology and inter-annual variations of global daily precipitation extremes (July 2013)
- Manuscript on observation-model comparison of inter-decadal (PDV) variations and global warming impacts on precipitation (Aug./2013)
- Manuscript on trends of mean and extreme precipitation over last 30 years: observations vs. models (Feb. 2013)

Recent Publications:

Gu, G., and R. Adler, 2012. Interdecadal Variability/Long-Term Changes in Global Precipitation Patterns during the Past Three Decades: Global Warming and/or Pacific Decadal Variability? *Climate Dynamics.* doi: 10.1007/s00382-012-1443-8.

Adler, R. F., G. Gu, and G. Huffman, 2012. Estimating Climatological Bias Errors for the Global Precipitation Climatology Project (GPCP). *Journal of Applied Meteorology and Climatology,* 51, 84-99.

Gu, G., and R. F. Adler, 2011: Large-scale, interannual relations among surface temperature, water vapor, and precipitation with and without ENSO and volcano forcings. *International Journal of Climatology.* DOI: 10.1002/joc.2393.

Date submitted: January 2013

Characterizing Uncertainties in Large-Scale Atmospheric Heating Distributions Derived from TRMM Observations and Reanalysis Datasets

NASA ENERGY AND WATER CYCLE STUDY NEWS

W. S. Olson, PI, JCET/UMBC; M. Grecu, X. Jiang, T. S. L'Ecuyer, M. G. Bosilovich, S. Zhang, and G. Gu

Objective: To better understand the uncertainties in large-scale atmospheric latent, eddy sensible, and radiative heating rates from both spaceborne radar/microwave remote sensing, as well as reanalysis estimates from different prediction centers.

Approach:

• quantify the sensitivity of TRMM large-scale heating estimates to uncertainties in heating algorithm assumptions and a priori information.

• examine the TRMM vs. reanalysis differences in light of algorithm uncertainties for several large-scale heating products.

• study composites of TRMM vs. reanalysis heating differences stratified by rain intensity, convective/stratiform rain proportion, mean precipitation depth, etc.

Data/Models:

• TRMM Precipitation Radar and Microwave Imager derived latent, eddy-sensible, and radiative heating products.

• uncertainty estimates of heating products.

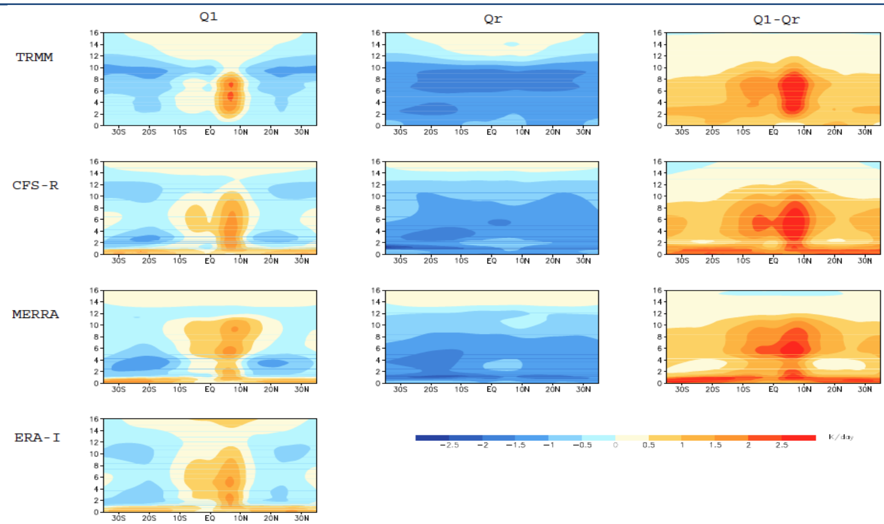
• reanalyses from CFS-R, MERRA, and ERA-Interim.

Value Added Integration (planned):

• merge TRMM latent+eddy sensible heating with Prof. L'Ecuyer's radiative heating product.

• collaborate with Prof. L'Ecuyer on uncertainties of diabatic heating product.

• collaborate with members of the Modeling and Water Cycle Prediction working group on reanalysis evaluation.



Total diabatic (first col.), radiative (second col.), and latent+eddy sensible (third column) zonal mean heating distributions from TRMM (first row), CFS-R reanalysis (second row)

Initial task timeframe (in bullet form)

- 08/13 assemble and regrid reanalysis data from 1998-2012.
- 12/13 develop error models for TRMM heating products.
- 03/14 re-process and regrid TRMM products for 1998-2012 period.
- 08/14 evaluate reanalyses using TRMM products.
- 12/14 revise products/estimated uncertainties as needed and re-evaluate reanalyses.
- 12/14 composite TRMM products and reanalyses to evaluate long-term mean, seasonal cycle, ENSO phases, and MJO heating distributions, and stratify differences by environmental parameters.

Needs/requests (in

none currently.

Initial Entry Slide

Integration of satellite products of radiative fluxes in support of hydrological modeling

Rachel T. Pinker

Objective:

To perform an in depth evaluation of current satellite shortwave (SW) and longwave (LW) products against ground observations and against each other to identify problematic regions and to generate error metrics needed for estimating *accuracy of hydrological parameters*. Will determine extreme statistics in radiative fluxes and evaluate trends in radiative regimes.

Approach:

Conduct comparison of radiative fluxes (SW and LW) from major satellite products and numerical models against a comprehensive set of ground observations; study the impact of aerosols on the reduction in SW fluxes under clear sky; determine global scale climatology of radiative fluxes and surface albedo, their spatial, seasonal, inter-annual and inter-decadal changes and trends (at the surface, TOA and atmosphere, clear and all sky conditions);

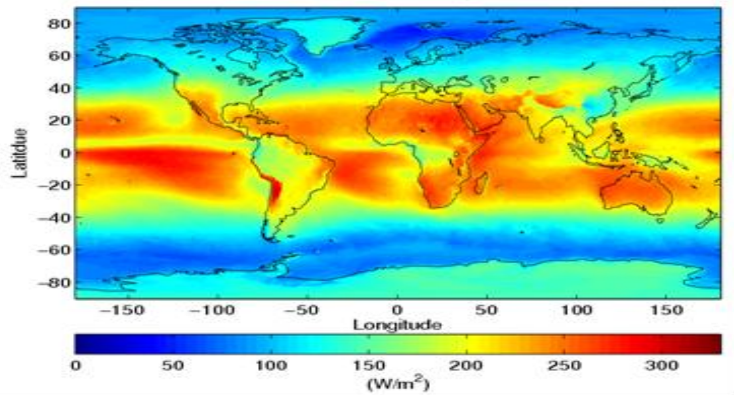
Data/Models:

Satellite products from ISCCP, MODIS, CERES; aerosol s from MODIS, MISR, GOCART; ERA Interim; Reanalysis II ; CFSR; Baseline Surface Radiation Network (BSRN) and ARM ground truth.

Value Added Integration (planned):

Integrate and interpret *past, and current space based and in situ observations into products that are global in scope and provide metrics on their variability and quality.* The emphasis will be on observations of sufficient length to allow addressing the primary categories of NEWS projects and goals (*Droughts, Evaporation & Latent Heating, Water and Energy Cycle Climatology and Modeling)*.

Figure with caption:



Three year mean all sky surface downwelling SW flux from MODIS (Terra and Aqua) for 2003-2005.

Initial task timeframe:

- 02/2013: Prepare all satellite data for analysis at daily time scale at same spatial resolution.
- 03/2013: Prepare model data for analysis (ERA Interim; Reanalysis II; CFSR)
- 04/2013: Prepare ground observations of SW total, diffuse and LW for analysis.
- 05/2013: Evaluate satellite SW estimates against ground observations at various time scales.
- 06/2013: Evaluate satellite SW diffuse and LW against ground observations.

Needs/requests (in bullet form):

Input from NEWS Investigators on required radiation metrics for their projects.

Date submitted: 01/16/2013

Initial Entry Slide

Quantifying the Relative Roles of Local Versus Remote Effects on North American Summertime Drought

Ayse Kilic (PI), Robert Oglesby and Qi Hu (co-I's)

Objective: The overall goal of the project is to quantify the relative roles of local and remote forcing in initiating, maintaining, and enhancing North American drought.

Approach: 1) Use of global and regional models to evaluate the combined effects of sea surface temperature (SST) anomalies and reduced soil moisture on drought.
2) Use a newly developed, combined ground and satellite-based ET dataset to constrain and improve the ability of the regional climate model to simulate the crucial ET fluxes. This addresses what is arguably the largest current impediment to full understanding of the local effects on drought.

Data/Models:
1) Ground-based flux measurements, 2) Large-scale datasets of ET from Land Surface Energy Budget Model, 3) Global Climate Model – the NCAR CAM4 Version 3.0, 4) Regional Climate Model - The Weather Research and Forecasting Model (WRF)

Value Added Integration (planned): This project explicitly builds on our NASA and NOAA-funded research over the previous 15 years. We focus on Drought & Flood Extremes, but also include elements of Evaporation and Latent Heating and Modeling and Water Cycle prediction. One of the primary benefits of this study is the development of large-scale datasets of ET based on MODIS.

Figure with caption:

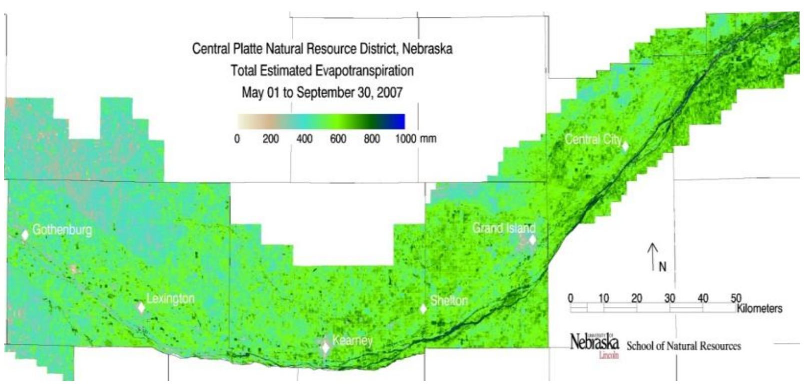


Fig. 1. Total ET (mm) during 2007 for Central Platte NRD, NE from Land Surface Energy Balance model.

Initial task timeframe (in bullet form)::

4/13: Make suite of WRF runs and make any new GCM simulations.
7/13: Ground-based flux measurements; QA/QC of weather data for METRIC runs, ET estimation with METRIC; simulations with WRF for regional analysis and comparison with measurements; coupling land surface–regional climate model
6/14: Complete analyses of basic suite of runs. Make new runs as appropriate with the improved ET. Final evaluation and intepretation of model results; guidelines for future work.
9/14: Ground-based flux measurements; ET estimation with METRIC, scaling within satellite instrument; integrating ET measurements into WRF, and make exploratory simulations for the study areas.

Needs/requests (in bullet form): None at this time.

Date submitted: 01/17/2013

Initial Entry Slide

Accelerating Changes in Arctic Ocean River Discharge Using Coupled Satellite- and Ground-based Measurements, 2002-Present

G. Robert Brakenridge, Irina Overeem, James Syvitski; University of Colorado

NASA ENERGY AND WATER CYCLE STUDY

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Objectives:

- Measure changes and trends in the timing of Arctic spring river ice break-up in relation to changing temperature regimes
- Measure changes and trends in total annual freshwater discharge into the ocean
- Evaluate causation and predictability thereof

Approach:

- Calibrate **129** River Watch discharge measurement sites >65 deg N
- Determine and validate ice break-up signals for each site
- Extract discharge and break-up dates records, 2002-2011
- Compare with instrumental records and WBM modeling results

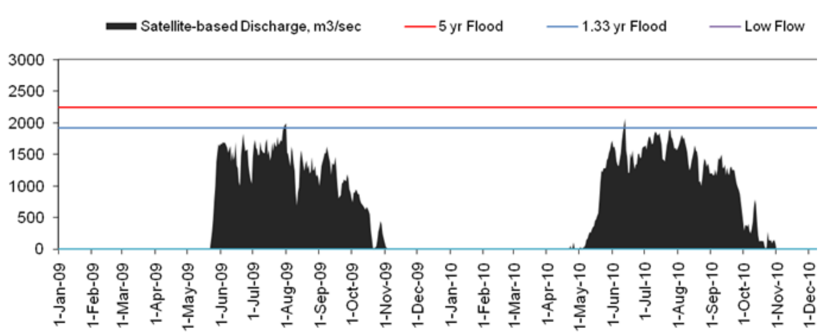
Data/Models:

- AMSR-E; AMSR-2
- Station observations on selected systems from Arctic: RIMS, HYDAT
- Water Balance Model (WBM) simulations of 1960-present

Value-Added Integration:

- Address questions on acceleration and storage of surface water
- Submit timing of freshwater flux delivery to Arctic Ocean to teams focused on SST/ heat transport
- Quantify flooding in northern high latitudes

Figure. Sample of River Watch results, Site 1051, McKenzie River, Canada. The complete record extends from 2002-2011. Black is discharge but not yet calibrated to actual units. Length of ice-covered versus ice-free season can already be determined.



Initial task timeframe:

- **1/2013**, Commence modeling runs; establish revised standard site files
- **4/1/2013**, Ingest model results into 129 site files (calibrate to discharge)
- **7/1/2013**. Trend analysis of ice-free seasons and timing of ice break-up
- **9/1/2013**, Trend analysis of discharge volumes (inc. instrumental records)
- **10/1/2013**, Collaborative research report with other NEWS projects

Requests (possible linkages to other NEWS projects):

- Acceleration of the Arctic water Cycle (Norris?)
- Changes in amount & timing of freshwater seasonal flood flux to the Arctic ocean; impacts on SST and sea ice dynamics (Curry; ,Clayton?)
- Changes in flooding and freshwater storage in Arctic rivers (timing and location, Lettenmaier?)

Date submitted: January 9, 2013

Investigation of Recycling Rate of Moisture in the Atmosphere From Observation and Model

PI: Xun Jiang (UH); Co-I: Yuk Yung (Caltech); Collaborator: Liming Li (UH)

NASA ENERGY AND WATER CYCLE STUDY

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Objective:

The precipitation, water vapor, and recycling rate of atmospheric moisture (*i.e.*, ratio of precipitation to column water vapor) are important elements affecting climate change. Our preliminary study [*Li et al.*, 2011] provides observational evidences of the temporal trends of these important elements in response to the global warming, which are predicted by some numerical models [*Allen and Ingram*, 2002; *Held and Soden*, 2006; *Stephens and Ellis*, 2008]. However, the physics and dynamics behind these observational results need more studies. We propose to first validate our preliminary results with more observational data sets (SSM/I, GPCP, GPCC, TRMM, NVAP, AIRS, and AMSR). Based on the reanalysis data sets (NCEP2, ECMWF, ECMWF-Interim) and the simulations from a numerical model (GISS-HYCOM), our final objective is to explore the underlying physics and dynamics of the temporal trends in precipitation, water vapor, and recycling rate.

Approach:

We will conduct the proposed studies by the following three approaches: (1) Data analyses of more observational data sets (*e.g.*, GPCC, TRMM, NVAP, AIRS, and AMSR) to validate the temporal trends of precipitation, water vapor, and recycling rate revealed in our preliminary study [*Li et al.*, 2011]; (2) Comparative studies between the observation and the numerical model (GISS-HYCOM); (3) Explore the physics behind the temporal variations and spatial patterns in precipitation, water vapor, and recycling rate.

Data:

I) Precipitation: Special Sensor Microwave Imager (SSM/I); Special Sensor Microwave Imager Sounder (SSMIS); Global Precipitation Climatology Project (GPCP); Gauge data from Global Precipitation Climatology Centre (GPCC); Tropical Rainfall Measuring Mission (TRMM)

II) Water vapor: SSM/I, NASA Water Vapor Project (NVAP), Atmospheric Infrared Sounder (AIRS), Advanced Micrcowave Scanning Radiometer (AMSR)

Model:

NASA Goddard Institute for Space Studies (GISS) atmospheric general circulation model coupled to the HYbrid Coordinate Ocean Model (HYCOM)

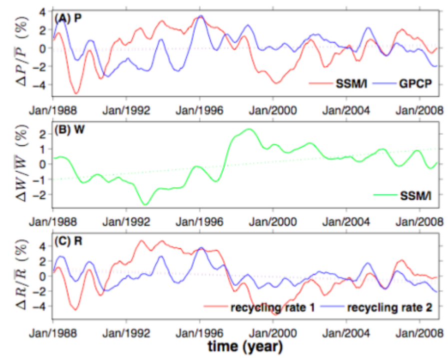


Figure 1: Temporal variations of precipitation, water vapor, and recycling rate averaged over ocean between 60°N and 60°S. (A) Precipitation (P). (B) Water vapor (W). (C) Recycling rate (R).

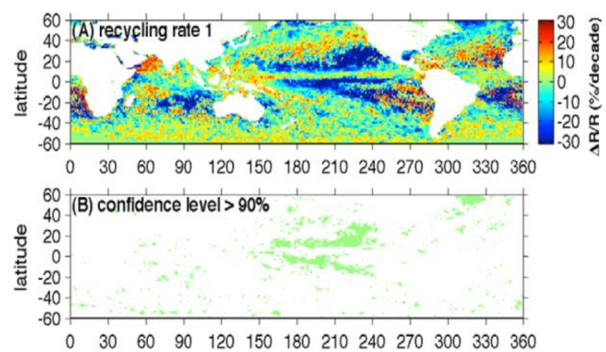


Figure 2: Spatial pattern of temporal variation of recycling rate (R) over the time period of 1988-2009. (A) Recycling rate based on SSM/I precipitation and SSM/I water vapor. (B) Area with confidence level of linear trend in (A) larger than 90%.

Initial task timeframe:

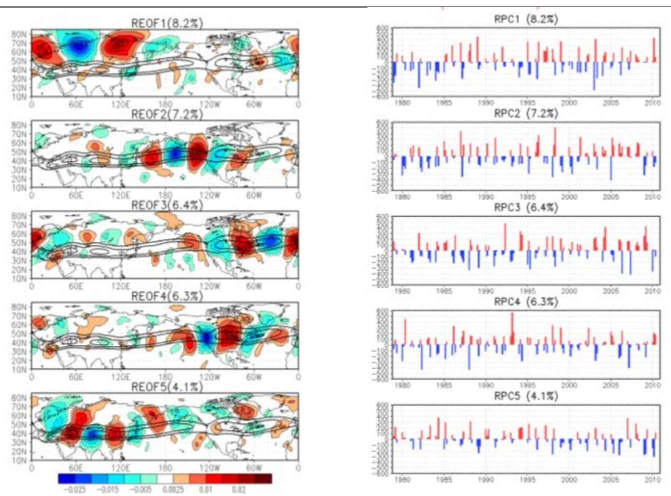
- 12/12-11/13: Assess trends and variability of precipitation, water vapor, and recycling rate from observations and carry out control and perturbed runs from GISS-HYCOM model.
- 12/13-11/14: Diagnose physics related to variability of precipitation, water vapor, and recycling rate from observation and model.

Warm-Season Short-term Climate Extremes in the Northern Hemisphere in a Changing Climate: The Role of Stationary Rossby Waves

Siegfried Schubert:GSFC, Hailan Wang:SSAI, Grant Branstator:NCAR, Haiyan Teng:NCAR

Objectives: 1) quantify the mechanisms linking stationary Rossby waves to short-term climate variability; 2) quantify the nature of the forcing of the stationary Rossby waves. and 3) investigate the potential impacts of Pacific and Atlantic decadal variability and global warming, on the Rossby waves and associated short-term climate extremes.

Approach: Various NASA NEWS and the MERRA datasets will be used to better characterize the temporal and spatial distribution of the past climate extremes and investigate their mechanisms. The output of century-long AMIP runs with the GEOS-5 AGCM, and a 12000-year SST climatology run with the NCAR CAM3 will be used to further quantify the maintenance and the nature of the forcing of the stationary Rossby waves. A set of idealized SST runs and an ensemble of future time-slice runs with the GEOS-5 AGCM will be used to investigate the potential impacts of PDV, AMV and global warming.



Left panels: The leading REOFs of the 250mb intraseasonal monthly v-wind anomalies for JJA of 1979-2010. Units are arbitrary. The thick black contours are the long-term JJA mean (1979-2010) 250hPa u-wind at 15, 20, 25m/s. Right panels: The monthly (June, July and August) total 250mb v-wind anomalies projected on the 5 leading REOFs for 1979 through 2010. Results are from MERRA following Schubert et al. (2011).

Data/Models:

Data: Precipitation, water vapor and atmospheric radiative flux products from NASA NEWS as well as the comprehensive MERRA dataset

Models: The GEOS 5 AGCM, NCAR CAM3, stationary wave model, mechanistic storm track model

Value Added Integration (planned):

Initial task timeframe (in bullet form)::

- Mo 1-6/Yr 1: Use NEWS data and MERRA to quantify mechanisms that link upper level circulation to changes in surface meteorology (includes focus on weather transients)
- Mo 7-12/Yr 1: Evaluate existing NASA and NCAR AMIP model simulations, to quantify the nature of the forcing of stationary Rossby waves and anomalous high frequency transients and extreme events associated with them
- Mo 1-6 /Yr 2: Complete work on AMIP simulations and MERRA, including the use of a stationary wave model and mechanistic stormtrack model to diagnose the nature of the Rossby wave forcing
- Mo 6-12/Yr 2: Carry out and analyze idealized SST runs forced with decadal modes and time-slice runs forced with global warming SST).

Needs/requests (in bullet form):

Date submitted: 1/4/13

Initial Entry Slide

Integrated analysis of atmospheric water cycle in intense marine storms

Judith Curry & Jiping Liu, Georgia Tech

Objective:

characterizing and understanding the coupled roles of surface latent heat fluxes, atmospheric latent heating, and precipitation in intense storms that are characterized by high surface wind speeds

- *What is the role of the surface evaporative flux and atmospheric latent heating in the life cycle of the integrated kinetic energy, precipitation, and intensification of hurricanes?*
- *How does the hydrological cycle in the high latitudes of the Southern Ocean influence the interannual variability of Antarctic sea ice?*

Approach:

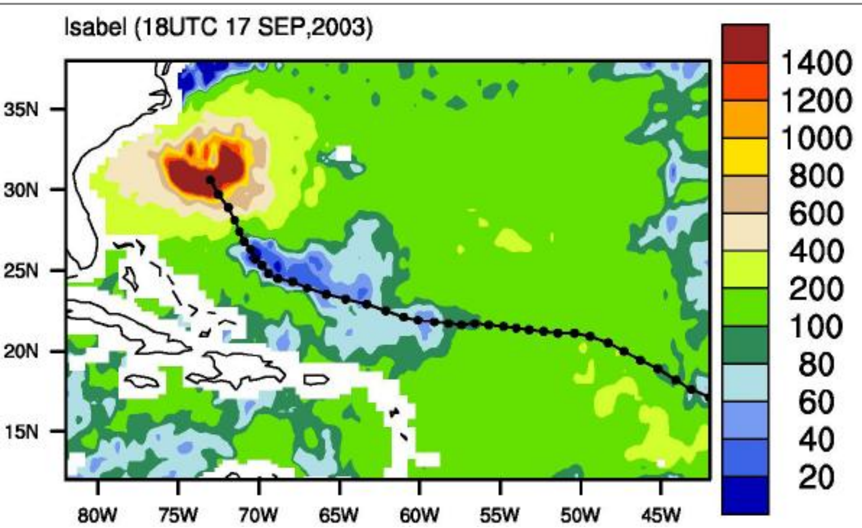
integration of multiple satellite and in situ data sets

Data/Models:

SeaFlux data set developed with previous NEWS funding, MERRA reanalyses, GPCP precipitation products, ISCCCP products sea ice data sets. NOAA Hurricane Hunter data, and the North Atlantic hurricane data from the Extended Best Tracks data set.

Value Added Integration (planned):

Collaboration will be sought with Clayson, Norris, Olson



Satellite-derived surface latent heat fluxes in Hurricane Isabel

Initial task timeframe (in bullet form)::

- High resolution wind fields in hurricanes
- Evaluation of CMIP5 simulations in the Southern Ocean

Needs/requests (in bullet form):

NONE

Date submitted: 1/15/12

Initial Entry Slide

Using NEWS Water and Energy Cycle Products to Investigate Processes that Control Cloud Feedback

PI: Hui Su, Jet Propulsion Laboratory, California Institute of Technology

NASA ENERGY AND WATER CYCLE STUDY

Objective:

- Investigate the physical processes that control cloud feedbacks
- Evaluate CMIP5 model simulations of water and energy cycle using NEWS products

Approach:

- Conditional sampling approach to examine clouds and their radiative effects in relation to their large-scale dynamic and thermodynamic environmental conditions
- Detailed error diagnosis to separate contributions of large-scale environments and cloud parameterizations for cloud simulation deficiencies

Data/Models:

- A-Train cloud and water vapor profiles
- ISCCP cloud fraction
- CERES radiative fluxes
- ECMWF reanalysis of winds and fluxes
- CMIP5 model simulations

Value Added Integration (planned):

Through combined data and modeling analysis, we will identify key physical parameters that are crucial to cloud feedbacks and use satellite observations to constrain models' projections of climate change

Figure with caption: *Su and Jiang* (2013, *J. Climate*)

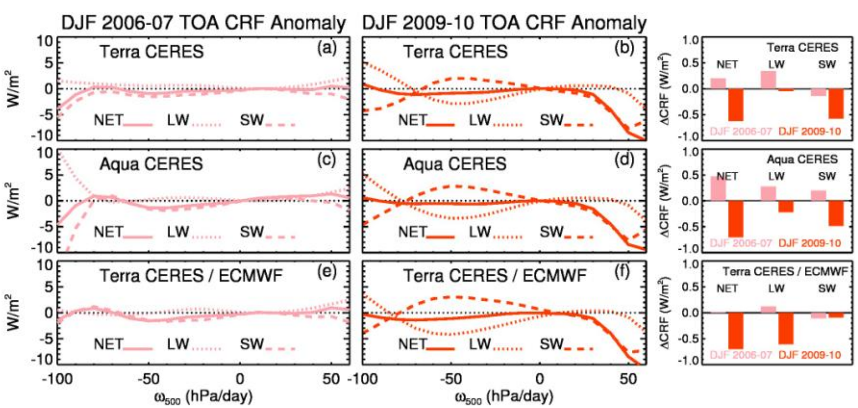


Figure 1: Changes of top-of-the-atmosphere (TOA) cloud forcing (CRF) as a function of ω_{500} from ECMWF for 2006-07 and 2009-10 El Niños. Right panels show the tropical (30ºS-30ºN) oceanic means.

Initial task timeframe (in bullet form):

- May/2012: investigate the cloud responses during the two recent El Niños
- June/2012: revised manuscript on El Niños submitted to J. Climate
- July/2012: worked on CMIP5 model evaluations and cloud error diagnosis
- Dec/2012: manuscript on CMIP5 cloud simulations accepted by JGR
- Jan-Mar/2013: Evaluate ISCCP cloud simulator results from CMIP5 models
- Apr-Jun/2013: Analyze CMIP5 RCP simulations of cloud changes and relate to climate sensitivity; Use NEWS products to differentiate models
- Jul-Sep/2013: Compare cloud and radiative fluxes between A-Train and re-analyses products
- Oct-Dec/2013: Examine interannual and decadal changes of clouds; Identify key physical parameters that control cloud feedback

Needs/requests (in bullet form):

- Second-year funding of $130,000 in early 2013

Date submitted: January 3, 2013

Initial Entry Slide

Investigating the Impact of Land-PBL Coupling on the Water and Energy Cycle in NASA Model and Observation Products

NASA ENERGY AND WATER CYCLE STUDY NEWS

PI: Joseph A. Santanello, Jr. Team: C. Peters-Lidard, J. Susskind, E. Fetzer, T. Matsui, and S. Kumar

Objective:

•*Extend the development and evaluation of **local land-atmosphere coupling** (**'LoCo'**) diagnostics across broader temporal and spatial scales for NEWS model and observation products.*

•***AIRS radiance signatures** can be used to evaluate, intercompare, and constrain the representation of land-PBL coupling and its influence on the water and energy cycle.*

Approach:

•Evaluate the accuracy, variability, and limitation of land-PBL coupling using a suite of LoCo diagnostics at global 'hotspots' of L-A interactions.

•Compare the radiance spectra measured from AIRS against those from each of the model and observation products using satellite data simulator.

•Determine the sensitivity of radiance signatures to LoCo regimes using statistical techniques, and extend to the global coverage of AIRS.

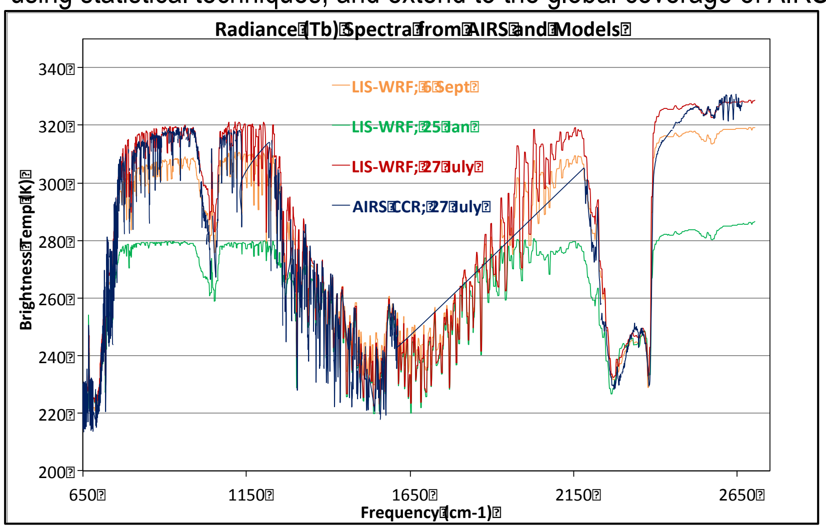


***Figure 1.** Brightness temperature spectra from AIRS CCR (blue) and those generated from LIS-WRF output using G-SDSU for 3 days of different seasonal and land-PBL characteristics (red = warm, dry, deep PBL, orange = moderate, green = cold, shallow).*

Data/Models:

•NASA's Land Information System (LIS) coupled to the NASA Unified WRF (NU-WRF) system (formerly LIS-WRF).

•MERRA, ERA-Interim, NARR, CFSR, GLDAS

•AIRS cloud-cleared radiance (CCR) product, Version 6

•In-situ and radiosonde observations at SGP, AMMA

Value Added Integration (planned):

•Coupling analysis for MERRA, MERRA-Land, and MERRA-GIO (Bosilovich)

•Quantifying local effects on North American drought (Oglesby)

•Sensitivity of AIRS to LoCo during extremes (Albertson, Dong)

•Consistency in satellite-based ET with AIRS CCRs (Wood, Lipton)

Initial task timeframe (in bullet form):

- 04/13: Case study selection; acquire/assess AIRS V6 and reanalysis data; SDSU development; NU-WRF simulations; begin LoCo analysis (Task 1)
- 10/13: LoCo analysis and SDSU/AIRS evaluation (Task 1 and 2)
- 04/14: Statistical analysis; extend to AMMA domain (Task 3)
- 10/14: Extend to additional sites, models, and data products

Needs/requests (in bullet form):

- Connection w/Oglesby project.
- Summary/status of prior working group and integration activities to inform both new and continuing NEWS PIs and aid future integration.

Date submitted: December

Initial Entry Slide

Characteristics of and Relationships Between Surface Heat and Moisture Fluxes and Ocean-Atmosphere Variability

PI: Carol Anne Clayson Team: Brent Roberts

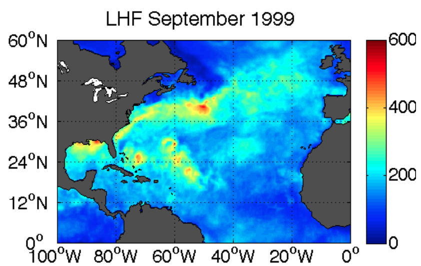
NASA ENERGY AND WATER CYCLE STUDY
NEWS

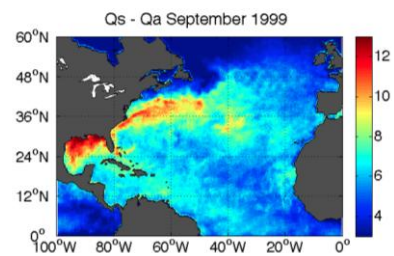
Objectives:

- Determine how distributions of air-sea heat and moisture fluxes vary in space/time, and how these distributions relate to the lower atmosphere, sea surface temperature, and clouds.
- Determine what local weather states are associated with surface heat and moisture flux distributions, and the cause of variations over time.
- Determine how distributions and weather states vary within larger-scale climate variability, and the extent to which this can be determined given the changing sampling characteristics.

Approach:

- Characterize basic properties of surface heat and moisture flux distributions. Construct multivariate joint probability density functions to evaluate feedbacks between atmosphere and ocean.
- Composite flux, cloud, and other data into weather regimes. Evaluate variations in distributions in time, space, and through climate regimes.





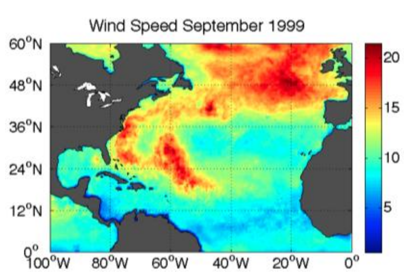


Figure 1. *95th percentile of latent heat flux (LHF), wind speed, and humidity difference (Qs-Qa) in September 1999. High LHFs from Hurricanes Floyd and Gert occur, as well as a cold air outbreak over the Gulf of Mexico. High winds cause the high LHF for the hurricanes, whereas high air-sea humidity differences cause the high LHF associated with the cold air outbreak, as very dry continental air flows over the Gulf. High LHF during mid-latitude Atlantic storms are due to both high wind speed and high humidity differences.*

Data/Models:

- SeaFlux (winds, surface temperatures/humidity, latent/sensible heat fluxes)
- ISCCP (cloud properties)
- GEWEX SRB (surface radiative fluxes)
- TRMM Multi-satellite Precipitation Analysis and HOAPS (precipitation)
- TRMM Level 2A12 Hydrometeor Profile Product for (latent heating profiles)
- For comparisons: GSSTF2b, MERRA

Value Added Integration (planned):

- Coupling of analysis with groups focusing on cloud processes, atmospheric moisture variability (possible Rapp, Norris, Bennartz, Olson, Su, Taylor)
- Connection with groups focusing on extremes (Curry)
- Analysis of MERRA cloud and surface flux relationships (Bosilovich)
- Connecting weather and climate variability (Adler, Wood, Houser)

Initial task timeframe:

- 06/13: Assemble necessary datasets. Perform distribution analysis for 1998-2007.
- 12/13: Calculate weather states and composite surface and atmospheric parameters for evaluation of flux dependencies. Compare results among products and with MERRA.
- 06/13: Extend analysis to 1988 – 2007. Compare to earlier analysis for stability of statistics. Perform subsampling for climate analysis.
- 12/13: Examine variability as a function of climate states. Compare with MERRA.

Needs/requests:

- WHOI component still awaiting funds.
- Current list of currently funded NEWS PIs to aid with integration.

Date submitted: January 2013

Initial Entry Slide

Identifying extreme precipitation "hot spots" in the changing tropical-midlatitude interaction using MERRA and satellite data

PI: S-Y Simon Wang. Co-I: Robert R. Gillies (Utah State University)

NASA ENERGY AND WATER CYCLE STUDY NEWS

UTAH CLIMATE CENTER

Objective:

- Develop a diagnostic (economical) approach for identifying extreme precipitation events, towards the 'seamless prediction of weather and climate' of model development.

Approach:

- Combine *climate* and *weather* diagnostics to identify the potential and geographic extent for extreme precipitation events, with a focus on the intersection region between tropics and midlatitudes.
- Utilize MERRA and TRMM data in conjunction with weather forecasting technique to develop an *extreme precipitation threat* that is not constrained by the limitation of model resolutions.
- Adopt this method for GISS and other CMIP5 models to assess the *extreme precipitation threat* in future climate projections.

Data/Models:

- MERRA, ERA-Interim, CFSR, JRA
- TRMM (for MCS)
- GISS and CMIP5 models (for projection)

Value Added Integration (planned):

- Joint analysis on impact of extreme precipitation due to tropical expansion (J. Norris)
- Combined exploration with intense marine storms (J. Curry)
- Evaluation of severe MCSs from the regional water budget perspective (M. Bosilovich)
- Parallel assessment for short-term climate extremes in future climate (S. Schubert)

(a) Boundary separating the midlatitude regime and the tropical regime (shaded belt) and the locations of frequent (red arrows) or recorded (orange arrows) low-level jets

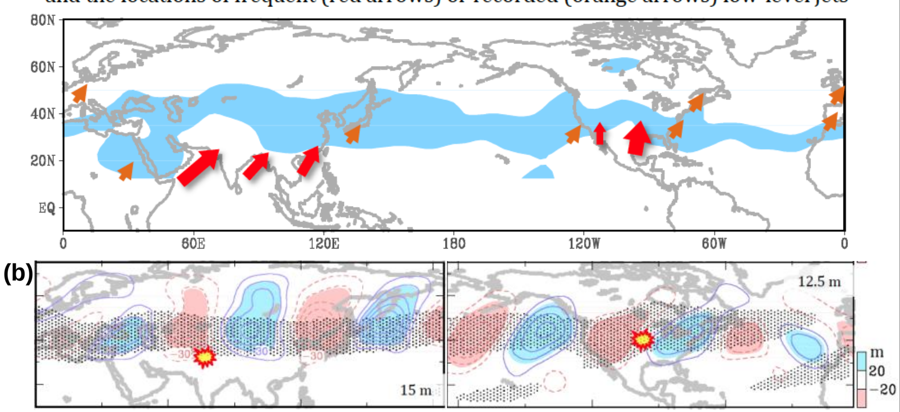


Figure. (a) The transition boundary (blue) between the midlatitude and tropical dynamics regimes, overlaid with the low-level jet distributions (arrows) around the globe. (b) Short-wave regime of circulation anomalies associated with the 2010 Pakistan flood (left) and the 2008 Iowa flood (right), both showing a wave-train structure that we found coincident with the long-term trend.

Initial task timeframe (in bullet form):

- 04/15: Best predictors of MCSs identified; Extreme precipitation activity constructed (Task 1)
- 07/15: Attribution and linkage study between CGT (circulation elements), low-level jets, and MCS activity completed (Task 1 and 2)
- 09/15: Extreme precipitation threat / probability formulated (Task 3)
- 11/15: Long term changes in extreme precipitation threat examined

Needs/requests (in bullet form):

- Connection with Norris and Schubert projects.
- Comparison with Curry and Bosilovich results.
- Summary of prior working group and integration activities to inform both new and continuing NEWS PIs and aid future integration.
- Needs from stakeholders (for prediction/projection data)